

CLAIMS

What is claimed is:

1. An ignitable solid material comprising:

5 a metal-producing reaction mixture that includes:
a reducing agent; and
a metallic compound powder;
a heat-retaining material; and
a binder.

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2. The material of claim 1, wherein the reducing agent includes a reductant metal powder.

15 3. The material of claim 2, wherein the reductant metal powder includes a powder selected from the group consisting of aluminum powder and copper powder.

4. The material of claim 1, wherein the metallic compound powder includes a metal oxide powder.

20 5. The material of claim 4, wherein the metal oxide powder includes a transition metal oxide powder.

25 6. The material of claim 5, wherein the transition metal oxide powder includes a metal oxide selected from the group consisting of iron oxide, copper oxide, manganese dioxide, and titanium dioxide.

7. The material of claim 1, wherein the heat-retaining material includes sand.

30 8. The material of claim 1, wherein the binder includes a material selected from the group consisting of sodium silicate and potassium hydroxide.

9. The solid material of claim 1, in a combination with an insulating material covering part of an outer surface of the solid material.

10. The combination of claim 9, wherein the insulating material includes a ceramic material.

11. The combination of claim 9, wherein the insulating material includes a 5 ceramic fiber material.

12. The combination of claim 11, wherein the ceramic fiber material includes a ceramic blanket.

10 13. The combination of claim 9, further comprising an exothermic ignition material between part of the insulating material and the solid material.

14. The material of claim 1, in combination with an exothermic ignition material in contact with the solid material.

15 15. The material of claim 1, wherein the material is formed from a slurry that includes 33-56% iron oxide, 13-22% aluminum, 18-36% sand, 2-8% sodium silicate, and 3-12% water.

20 16. A heat producing-device comprising:
a metal-producing ignitable solid material; and
an insulating material covering at least part of an outer surface of the solid material.

25 17. The device of claim 16, wherein the insulating material leaves a side of the outer surface of the solid material uncovered, and wherein ignition of the solid material causes heat to be preferentially emitted along the side.

30 18. The device of claim 17, wherein the insulating material has an opening therein, exposing part of another side of the outer surface of the solid material.

19. The device of claim 18, further comprising an exothermal ignition material in the opening.

20. The device of claim 19, further comprising a metal foil ignitor in the ignition material.

21. The device of claim 19, wherein the ignition material includes a powdered 5 mixture of a reductant material and a metal oxide.

22. The device of claim 16, further comprising a protrusion; wherein the protrusion contains an exothermic ignition material in contact with the solid material; and

10 wherein the protrusion includes a removable cover.

23. The device of claim 22, wherein the cover of the protrusion is a substantially-continuous part of the insulating material.

15 24. The device of claim 23, wherein the insulating material includes ceramic fibers.

25. The device of claim 22, wherein the ignition material includes a powdered mixture of a reductant material and a metal oxide.

20 26. The device of claim 16, wherein the solid material includes:
a metal-producing reaction mixture that includes:
a reducing agent; and
a metallic compound powder;
25 a heat-retaining material; and
a binder.

30 27. The device of claim 26, wherein the reducing agent includes a reductant metal powder selected from the group consisting of aluminum powder and copper powder.

28. The device of claim 26, wherein the metallic compound powder includes a metal oxide selected from the group consisting of iron oxide, copper oxide, manganese dioxide, and titanium dioxide.

5 29. The device of claim 26, wherein the heat-retaining material includes sand.

30. The device of claim 26, wherein the binder includes a material selected from the group consisting of sodium silicate and potassium hydroxide.

10 31. The device of claim 26, wherein the solid material is formed from a slurry that includes 33-56% iron oxide, 13-22% aluminum, 18-36% sand, 2-8% sodium silicate, and 3-12% water.

15 32. A method of heating at least a portion of an object, comprising:
placing an ignitable solid material on the object;
chemically reacting the solid material to exothermically produce molten metal;
and
using heat produced by the chemical reaction to heat the at least a portion of
20 the object;
wherein the molten metal is retained in the solid material during the
chemically reacting.

33. The method of claim 32,
25 wherein the solid material includes a substantially homogeneous mixture of:
a metal-producing reaction mixture that includes:
a reducing agent; and
a metallic compound powder;
a heat-retaining material; and
30 a binder; and
wherein the chemically reacting includes chemically reacting the reducing
agent and the metallic compound powder.

34. The method of claim 32, wherein the chemically reacting includes reacting iron oxide and aluminum.

35. The method of claim 32, wherein a material matrix of the solid material is
5 maintained during the reacting.

36. The method of claim 32, wherein the object is an object to be welded.

37. The method of claim 32, wherein the object is a steel rail.

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38. The method of claim 32, wherein the heating includes heating the at least a portion of the object to a temperature in excess of 200 °F.

39. The method of claim 32, wherein the heating includes melting at least
15 part of the object.